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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/674,631	09/29/2003	Shashank C. Deshmukh	8233/ETCH/SILICON/JB.	4703

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EXAMINER

UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
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1765

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/07/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

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Office Action Summary

Application No.

10/674,631

Applicant(s)

DESHMUKH ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 November 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 and 32-43 is/are pending in the application.
- 4a) Of the above claim(s) 22-41 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21, 42 and 43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input checked="" type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. <u>10/26/2006</u> |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114 to correct error made by the Examiner in withdrawing the 112 (1) rejection in the Interview of 10/25/2006. Applicant's submission filed on 11/6/2006 has been entered.

Specification

2. The amendment previously filed 3/14/2006 as well as the amendment filed 11/6/2006 are objected to under 35 U.S.C. 132(a) because they introduce new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material that is not respectively supported by the original disclosure is as follows: "wherein the pre-selected wavelength in nanometers is greater than or on the order of the initial thickness of the initial thickness of the material in Angstroms" and "wherein the pre-selected wavelength in nanometers is greater than or on the same order of magnitude as the initial thickness of the material in Angstroms" is not supported by the Specification [0018].

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-21, 42, and 43 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. In claims 1 and 11, lines 8-10 "wherein the pre-selected wavelength in nanometers is greater than or on the order of the initial thickness of the initial thickness of the material in Angstroms" lacks support in the Specification [0018 and 0028].

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 2, 4, 5, 7, 8, 9, 10, and 42; 11, 12, 15, 16, 18, 19, 20, 21 and 43 are rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al. (US 5,835,221).

Lee discloses a method used to monitor film thickness. Polarized light is made incident on the surface of a substrate with a film thereon that has a different reflectivity

than that of an underlying substrate. The substrate is subjected to conditions that change the thickness of the film on the substrate. The polarized light that is reflected from the substrate is detected at a selected wavelength or wavelengths and a trace of the intensity of the reflected light both parallel and perpendicular to the substrate surface overtime is obtained (Abstract). Lee further discloses the etching endpoints are identified by the cessation of oscillation or a change in slope of ellipsometric parameters in time as describe in US Patent 5,494,697, to Blayo et al., which is incorporated by reference.

Lee further discloses measuring the thickness of a patterned layer or layers of material on a substrate surface wherein the layers comprise 1500 Å (~150 nm) oxide (same as Applicants' high-k dielectric material layer and high-k gate dielectric layer), which overlies a 1125 Å (~112 nm) TiN, and 1625 Å (~162 nm) polysilicon (Table 1) and which were etched at 2.0 eV, 2.8 eV, 3.3 eV, and 4.0 eV (~ 620 nm, 443 nm, 376 nm, and 310 nm). Lee also discloses an oxide mask having a thickness of 1000 to 2000 Å (100-200 nm), 1000 Å thick titanium nitride formed over a 2000 Å (200 nm), polysilicon film and 70 Å (7 nm), thick gate oxide (column 7, lines 38-50).

As to claims 1-5, 7-10, and 42; 11, 12, 14-16, 18-21, and 43, the aforementioned reads,

A method for determining the endpoint of an etch process, comprising:

- (a) providing a substrate comprising a material layer having an initial thickness;
- (b) etching the material layer on the substrate;
- (c) directing radiation onto the substrate as the material layer is etched;

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(d) measuring a change in intensity for radiation reflected from the substrate at a pre-selected wavelength as the material layer is etched, wherein the pre-selected wavelength in nanometers is on the same order of magnitude as the initial thickness of the material layer in Angstroms; and

(e) terminating the etch step upon measuring a predetermined metric for the change in intensity radiation reflected from the substrate at the pre-selected wavelength.

It is noted Lee's disclosure of 620 nm is on the same order of magnitude of (1000 Å) as the thickness of the oxide mask, i.e. within a factor of 10. It is noted:

Orders of magnitude are generally used to make very approximate comparisons. If two numbers differ by one order of magnitude, one is about ten times larger than the other. If they differ by two orders of magnitude, they differ by a factor of about 100. Two numbers of the same order of magnitude have roughly the same scale: the larger value is less than ten times the smaller value. Google, Wikipedia, the free encyclopedia, page 1 of 4, http://en.wikipedia.org/wiki/Orders_of_magnitude, retrieved 10/25/2006.

For example,

$$\log 1000 = 3.00$$

$$\log 620 = 2.79$$

The difference in magnitude (3.00 - 2.70) is 0.21 such that the larger value is less than ten times the smaller value.

Claim Rejections – 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 6 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 5,835,221), as applied respectively to claims 1-5 and claim 11 above, and in view of Jerbic (US 5,348,614).

Lee differs in failing to teach filtering wavelengths other than the pre-selected wavelength.

Jerbic discloses, "Actinometry equipment is commercially available, for example, from EG&G Princeton Applied Research, which manufactures a single spectrometer with multiple wavelength sensing of up to 512 wavelengths simultaneously using sensors with appropriate filters. Such equipment has been used to sense the endpoint

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of a plasma assisted process, such as a plasma etch process by sensing for the appearance, or disappearance, of certain wavelengths emitted by a particular species" (column 3, line 66 – column 4, line 6).

Since Jerbic illustrates optical filters can single out certain wavelengths emitted by a particular species in the endpoint of a plasma etch, then one having ordinary skill in the art at the time the invention was made would have been obvious to modify Lee by using a filter as taught by Jerbic for the purpose of sensing the endpoint in a plasma etch process (Jerbic, column 4, lines 2-6).

10. Claims 3 and 42; and 13-14 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (US '221) as applied to claims 1 and 11 above, and further in view of Ngai et al. (US 6,518,106 B2).

Lee differs in failing to teach wherein the thickness of the material layer and gate dielectric layer is 5 to 300 Angstroms, respectively in **claims 3 and 14**;

wherein the gate dielectric layer comprises at least one film of hafnium dioxide (HfO_2) and hafnium silicate (HfSiO_2), in **claim 13**; and

wherein the thickness of the material layer and gate dielectric layer is 20 to 200 Angstroms, respectively in **claims 42 and 43**.

Ngai teaches forming gate dielectric over a semiconductor substrate in forming a transistor and thermally growing the gate dielectric to a thickness of approximately 1 to 50 Angstroms. Ngai also teaches the gate dielectric is SiO_2 and can be an oxide such

as HfO₂ (same as Applicants' high k material layer and gate dielectric layer), (column 2, lines 34-56).

Since Ngai illustrates using SiO₂ and HfO₂ as gate dielectric is known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to select HfO₂ as a gate dielectric (same as Applicants' high k material layer and gate dielectric layer), as taught in the Ngai reference because their use is known in manufacturing of semiconductor devices such as transistors (Ngai, column 1, lines 6-9 and column 2, lines 34-56, and column 4, lines 10-12).

Response to Arguments

11. Applicants' arguments filed 11/6/2006 have been fully considered but they are not persuasive. Applicants traverse the 112(1) rejection of claims 1-21, 42, and 43 as failing to provide support for "wherein the pre-selected wavelength in nanometers is greater than or on the order of the initial thickness of the material in Angstroms" lacks support in the Specification [0018]. Applicants argue that support for the said limitation is found in [0018 and 0028].

Applicants' arguments are unpersuasive because the Specification fails to fully disclose "wherein the pre-selected wavelength in nanometers is greater than or on the same order of magnitude as the initial thickness of the material layer in Angstroms and of the gate dielectric layer in Angstroms.

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12. Applicants traverse the rejection of claims 1- 5 and 7-10; 11,12, 15, 16, and 18-21, under 35 U.S.C. § 102(b) as being anticipated by Lee (US 5,825,221). Applicants argue Lee fails to disclose “wherein the pre-selected wavelength in nanometers is greater than or on the same order of magnitude as the material layer in Angstroms” as recited in claim 1 and “wherein the pre-selected wavelength in nanometers is greater than or on the same order of magnitude as the initial thickness of the gate dielectric layer in Angstroms” as recited in claim 11. Applicants further argue in Table A (below), everyone of the wavelengths (310 – 620 nm) cited by the Examiner, as well as every wavelength disclosed in the reference, is on the order of hundreds of nanometers. While the thickness of the high-k dielectric is thousands of (1000 - 2000 Å) Angstroms. Hence, Lee fails to teach or suggest a process wherein the pre-selected wavelength in nanometers is greater than or on the same order of magnitude as the initial thickness of the material layer and gate dielectric layer, respectively in claims 1 and 11.

Applicants’ argument is acknowledged but is unpersuasive because Lee discloses a substrate surface comprises a 1500 Å (~150 nm) oxide (same as Applicants’ high-k dielectric material layer) and high-k gate dielectric layer that is etched at 2.0 eV, 2.8 eV, 3.3 eV, and 4.0 eV (~ 620 nm or 6200 Å, 443 nm or 4430 Å, 376 nm or 3760 Å, and 310 nm or 3100 Å). Lee also discloses an oxide mask having a thickness of 1000 to 2000 Å (100-200 nm), 1000 Å thick titanium nitride formed over a 2000 Å (200 nm), polysilicon film and 70 Å (7 nm), thick gate oxide (column 7, lines 38-50). Table A below shows an example of a pre-selected wavelength in nanometers that is greater than or on the order of magnitude as the initial thickness of the material layer

in Angstrom. For example, the preselected wavelength of 620 nm is on the same magnitude of as 1000 Å, i.e. within a factor of 10.

Table A. Comparison of Preselected Wavelengths in nm to Intensity of Initial Thickness of High-k Dielectric Material to be Etched in Angstroms.

Preselected Wavelength,	eV	2	2.8	3.3	4.0
	nm	620	443	376	310
Thickness of high-k dielectric, Å		1000-2000	1000-2000	1000-2000	1000-2000

13. Applicant's arguments, see Remarks, filed 11/6/2006, with respect to the rejection(s) of claim(s) 3, 14, 42, and 43 under 35 U.S.C. § 103(a) over Lee (US 5,835,221) in view of Jang et al. (US 6,599,847) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Lee (US 5,835,221) in view of Ngai et al. (US 6,518,106 B2).

14. Applicant's arguments, see Remarks, filed 11/6/2006, with respect to the rejection(s) of claim(s) 6 and 17 under 35 U.S.C. § 103(a) over Lee (US 5,835,221) in view of Grimbergen (6,406,924 B1) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a

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new ground(s) of rejection is made over Lee (US 5,835,221) in view of Jerbic (US 5,348,614).

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. "Order of magnitude" from Wikipedia, the free encyclopedia was retrieved from Google at http://en.wikipedia.org/wiki/Orders_of_magnitude, and used to show 620 and 1000 are the same order of magnitude.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

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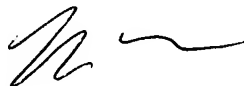
USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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January 24, 2007

NADINE G. NORTON
SUPERVISOR

A handwritten signature in black ink, appearing to be 'Nadine', written over the printed name and title.